THA– 4S SERIES
CORE TRANSCEIVER

Original, 09/95

NMP Part No. 0275168

After Sales Technical Documentation
THA–4S Series Transceiver

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Amendment Record Sheet

Chapter 1 Foreword

Chapter 2 Performance Specifications

Chapter 3 Transceiver Overview

Chapter 4 System Module

Chapter 5 Display Module

Original, 12/95

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THA–4S Series Transceiver

AMENDMENT RECORD SHEET

Amendment Number	Date	Inserted By	Comments

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Chapter 1

FOREWORD

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CHAPTER 1 – FOREWORD

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Introduction

Service Manual Structure

The service manual is structured as a series of stand–alone booklets. The 'core' service manual consists of the following:

THA–4S Series Transceiver booklet comprising

Chapter 1: Foreword

Chapter 2: Performance Specifications

Chapter 3: Transceiver Overview

Chapter 4: System Module

Chapter 5: Display Module

Appendix to the Transceiver booklet covering a specific variant (ie THA–41S comprising:

Chapter 1: Foreword

Chapter 2: Transceiver variant

Chapter 3: Quick Guide

TESLA Service Software

The accessory booklets comprise an overview; separate booklets covering those accessories deemed to be serviceable; and a booklet covering the remaining (non–serviceable) accessories.

Accessory Overview

LCH–2 Cigarette Lighter Charger

HFJ–2 Handsfree Junction Box

JBH–1 Cable Junction Box

BSH–2 Booster Kit

CHH–6 Desktop Charger

CHH–7 Handsfree Desktop Charger

PHF–2 Compact Handsfree Unit

Non–serviceable Accessories

Other booklets available are:

CARK14 Installation Guide

CARK15 Installation Guide

Company Policy

Our policy is of continuous development; details of all technical modifications will be included with service bulletins.

While every endeavour has been made to ensure the accuracy of this document, some errors may exist. If any errors are found by the reader, NOKIA MOBILE PHONES Ltd should be notified in writing.

Please state:

Title of the Document + Issue Number/Date of publication

Latest Amendment Number (if applicable)

Page(s) and/or Figure(s) in error

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Finland

Warnings and Cautions

Please refer to the phone's user guide for instructions relating to operation, care and maintenance including important safety information. Note also the following:

Warnings:

1. CARE MUST BE TAKEN ON INSTALLATION IN VEHICLES FITTED WITH ELECTRONIC ENGINE MANAGEMENT SYSTEMS AND ANTI–SKID BRAKING SYSTEMS. UNDER CERTAIN FAULT CONDITIONS, EMITTED RF ENERGY CAN AFFECT THEIR OPERATION. IF NECESSARY, CONSULT THE VEHICLE DEALER/MANUFACTURER TO DETERMINE THE IMMUNITY OF VEHICLE ELECTRONIC SYSTEMS TO RF ENERGY.
2. THE HANDPORTABLE TELEPHONE MUST NOT BE OPERATED IN AREAS LIKELY TO CONTAIN POTENTIALLY EXPLOSIVE ATMOSPHERES EG PETROL STATIONS, BLASTING AREAS ETC. PERMISSION MUST BE OBTAINED TO USE THE PHONE IN AIRCRAFT.
3. OPERATION OF ANY RADIO TRANSMITTING EQUIPMENT, INCLUDING CELLULAR TELEPHONES, MAY INTERFERE WITH THE FUNCTIONALITY OF INADEQUATELY PROTECTED MEDICAL DEVICES. OTHER ELECTRONIC EQUIPMENT MAY ALSO BE SUBJECT TO INTERFERENCE.

Cautions:

1. Servicing and alignment must be undertaken by qualified personnel only.
2. Ensure all work is carried out at an anti–static workstation and that an anti–static wrist strap is worn.
3. Ensure solder, wire, or foreign matter does not enter the telephone as damage may result.
4. Use only approved components as specified in the parts list.
5. Ensure all components, modules screws and insulators are correctly re–fitted after servicing and alignment. Ensure all cables and wires are repositioned correctly.

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Chapter 2

PERFORMANCE SPECIFICATIONS

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CHAPTER 2 – PERFORMANCE SPECIFICATIONS

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Introduction

This chapter contains a list of products/modules together with their associated order codes, and details of the performance specifications for the THA–4S Series Transceiver. The performance specifications are split into general, transmitter, and receiver functions.

Product and Module List

NOTE: The battery capacities quoted are minimum values.

Unit/type:	Product code:	Module code:
Transceiver THA–41S	0500428	
• system module KS4S		0200620
• display module KL1		0200261
• mechanics MTHA41S		0260721
****Transceiver THA–42S**	0500429	
• system module KS4S		0200620
• display module KL1		0200261
• mechanics MTHA42S		0260720
Battery Pack BTH–8L (350 mAh)	0670068	
Battery Pack BTH–8S (380 mAh)	0670054	
Battery Pack BTH–8SM (550 mAh)	0670055	
Battery Pack BTH–8H (790 mAh)	0670056	
Battery Pack BTH–8HM (990 mAh)	0670057	
AC Travel Charger ACH–3U (US)	0675003	
AC Rapid Travel Charger ACH–4U (US)	0675012	
AC Power Supply ACS–6U (US)	0680018	

**THA–42S is a future product.

Unit/type:	Product code:	Module code:
AC Travel Charger ACH–3E (Euro)	0675001	
AC Rapid Travel Charger ACH–4E (Euro)	0675008	
AC Power Supply ACS–6E (Euro)	0680016	
Cigarette Lighter Charger LCH–2	0675013	
• charging module AL4 (no spare parts available)		0200044
• mechanics MLCH2–2U (no spare parts available)		0260094
Desktop Charger CHH–6	0675041	
• charging module DC2H		0200296
• mechanics MCHH–6		0260337
Handsfree Desktop Charger CHH–7	0675040	
• DCXH1 module (comprising)		0200335
• module DC3H		0200334
• module DC4H		0200295
• mechanics MCHH–7		0260338
In–car Holder MBH–9	0630009	
• mechanics MMBH–9		0260339
• Installation kit KMKE–1		0260076
Anti–vibration Mount MKA–1	0945136	
Mounting Plate MKE–1	0650007	
• installation kit		0260076
Cable Clip CKH–1	0620016	
HF Junction Box HFJ–2	0694006	
• charging module BC4		0200045
• mechanics		0260065
Cable Junction Box JBH–1	0630008	
• mechanics		0260336

Unit/type:	Product code:	Module code:
Compact Handsfree Unit PHF–2	0630010	
Mounting Kit for above Unit KPHF–1	0260254	
Compact Handsfree Unit Charger LCP–2	0680022	
Booster BSH–2 (AMPS)	0500053	
• booster module BB4		0200101
• mechanics		0260110
(Booster) Mounting Bracket MBM–3	0700016	
• mechanics		0260010
• installation kit		0260108
Power Cable PCH–4	0730009	
HF Microphone HFM–3	0690001	
HF Speaker HFS–6	0692006	
Front Mount Cable SCE–2	0730014	
Extension Cable SCE–3	0730015	
RF Extension Cable XRH–1	0730017	
Swivel Mount HHS–1	0650008	
In–car Data Cable FDP–1	0750009	
Analog PCMCIA Card DTP–3	0750037	
PCMCIA Data Cable DLH–2	0730043	
Teleadaptor FDM–2	0750019	
Cable holder CKH–1	0620016	
Booster Kit BSHK–2	0082011	

Technical Specifications

General Specifications of THA–4S Series Transceiver

Temperature range	*–30° C to +60° C*
Operating time (with BTH–8SM)	
• talk time	*70 min*s
• standby time	*15 hrs*
Supply voltage	*5.3 V to 9.0 V (nominal 6.0 V)*
Nominal current consumption	
• standby mode	*38mA*
• conversation mode	*400mA*
Dimensions (h x w x d)	
• transceiver + BTH–8S	*147 x 54 x 17.5 mm*
• transceiver + BTH–8H	*147 x 54 x 23.4 mm*
• transceiver + BTH–8SM	*147 x 54 x 17.5mm*
Weight	
• transceiver + BTH–8S	*200 g*
• transceiver + BTH–8H	*345 g*
• transceiver + BTH–8SM	*215 g*

Electrical Specifications

Transceiver General Features

Number of channels	*AMPS: 832* *NAMPS: 2412*
Duplex spacing	*45 MHz*
Channel spacing	*AMPS: 30 kHz* *NAMPS: 10kHz*
Frequency tolerance	*AMPS : < ± 2.5 ppm* *NAMPS: ± 1ppm (AFC)*
Frequency control	*synthesized*
Voice modulation	*phase modulation*
Compander	*2:1*
Data modulation	*Manchester–coded, 16 kbaud FSK*
Data speed	*8 kbits*
Word format	*BCH encoded*

Receiver Branch

Frequency band	869 to 894 MHz
Rx First Intermediate Frequency	86.85 MHz
Rx Second Intermediate Frequency	450 kHz
Sensitivity	AMPS: better than –116 dBm (12 dBSINAD) NAMPS: better than–118 dBm (12 dBSINAD)
Adjacent channel selectivity	AMPS: > 16 dB NAMPS: > 18 dB
Alternate channel	> 60 dB
Spurious response rejection	> 60 dB
Intermodulation rejection	> 65 dB
RSSI dynamic range	> 60 dB
RSSI starting level	< –110 dBm
Harmonic distortion	< 5%
Blocking or desensitization outside ±1Mkz from receive frequency:	
• band A	better than –50 dBm
• band B	better than –23 dBm
AF DAF (2.9 kHz)	50 mV
Demod. audio phase	inverted
Demodulation noise	better than –32 dB
Demod. audio frequency response	6 db +1/–3db/octave pre–emphasis

Transmitter Branch

Frequency band	*824 to 849 MHz*
Number of channels	*AMPS: 832* *NAMPS: 2412*
PA efficiency	>55%
Reference voltage for regulators	*4.85 V ± 0.1 V*
Output power at all channels	
• PL2	*28 dBm*
• PL3	*24 dBm*
• PL4	*20 dBm*
• PL5	*16 dBm*
• PL6	*12 dBm*
• PL7	*8 dBm*
	(tolerances +2 dB, –4 dB)
Modulation distortion	*< 5 %*
Residual modulation	*< –35 dB*
TX on/off delay	*< 2 ms*
Wideband data	
• logic 0 corresponds to dev.	*+8 kHz (± 10 %)*
• logic 1 corresponds to dev.	*–8 kHz (± 10 %)*
Maximum deviation	*± 12 kHz*

Synthesizer's RX Branch

Frequency range	*955 to 981 MHz*
Output level to transmitter	*+3 dBm (–2 / +4dBm)*
Tuning voltage sensitivity	*12 – 18 MHz/V*
Centre channel tuning voltage	*2.5V ± 0.5 V*

Synthesizer's TX Branch

Frequency range	824 to 849 *MHz*
Output level to transmitter	*+5 dBm* (*± 2)*
Tuning voltage sensitivity	*2 – 3 MHz/V*
Centre channel tuning voltage	*2.5V ± 0.5 V*

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Chapter 3

TRANSCEIVER OVERVIEW

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CHAPTER 3 – TRANSCEIVER OVERVIEW

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Introduction

The THA–4S series phone is an advanced analog handportable cellular telephone designed for operation on the Dual Mode phone AMPS/NAMPS cellular system. The telephone contains many advanced user facilities and is designed for ease of maintenance.

The transceiver consists of two modules: a system module and a display module.

System Module

The system module performs the following functions:

- received audio processing
- transmitted audio processing
- data reception and transmission
- channel selection
- modulated RF signal reception and demodulation to baseband
- modulation of the Transmitter by the microphone and data signals
- application of the modulated Tx signal to the selected power level

The system module contains a microprocessor, which controls the main functions of the phone, and parts of the HW dependent user interface (earphone, microphone, alarm–beeper and keyboard contacts).

For convenience the non–RF sub–systems are referred to as the ’Baseband functions’, and the RF sub–systems as the ’RF functions’. Figures 1 and 2 show the RF and Baseband functional blocks respectively.

The RF functions provide the RF interface with the cellular system and demodulated audio signals to the analog sub–system. They also modulate audio signals from the analog sub–system.

The Baseband functions cover both analog sub–systems (responsible for all audio processing functions) and digital sub–systems (responsible for all digital signal processing functions) and the microcontroller / software (responsible for control and data processing functions).

Display Module

The display module comprises a supertwist–LCD, a display driver and volume control contacts.

Figure 1: RF Block Diagram

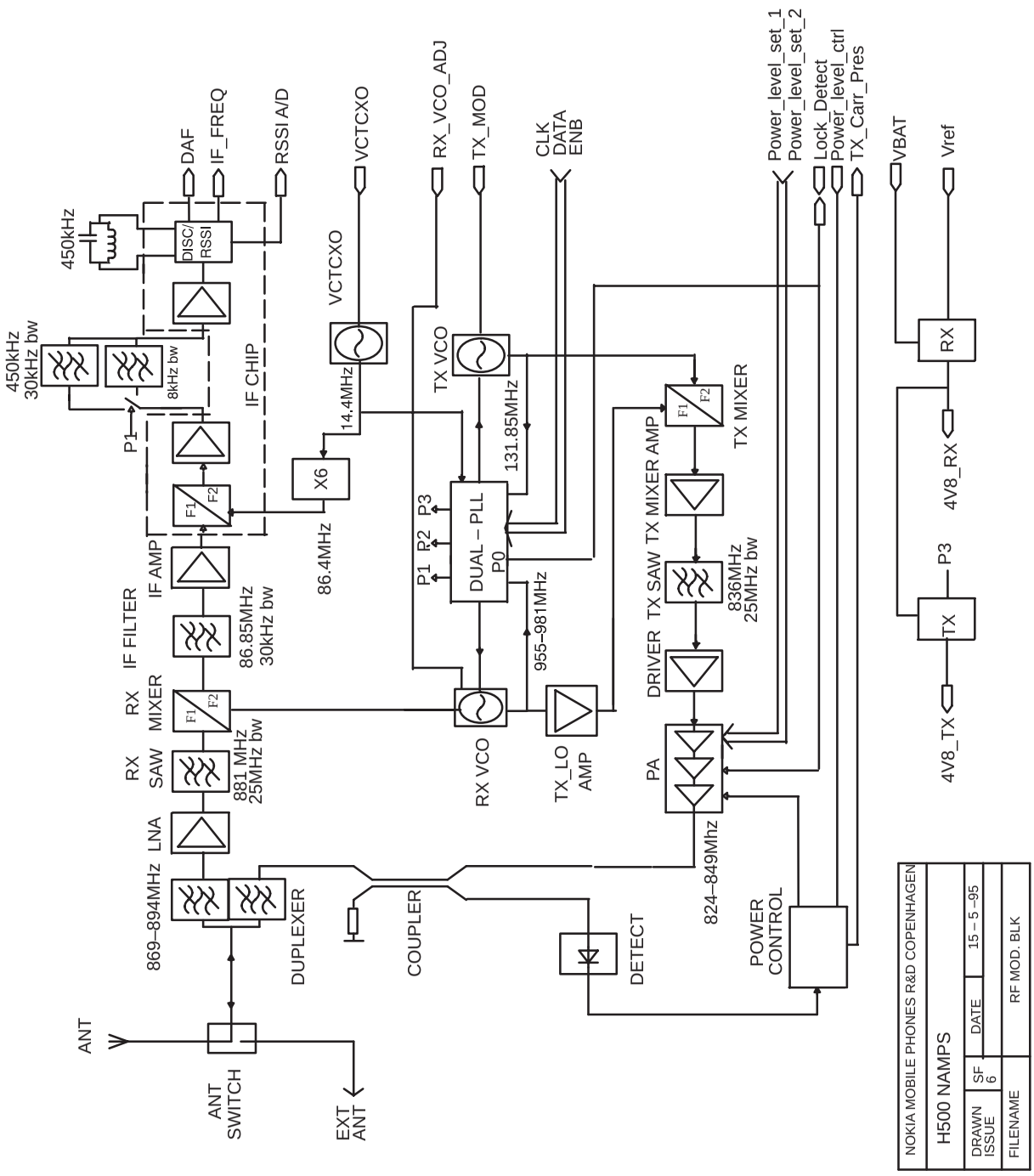
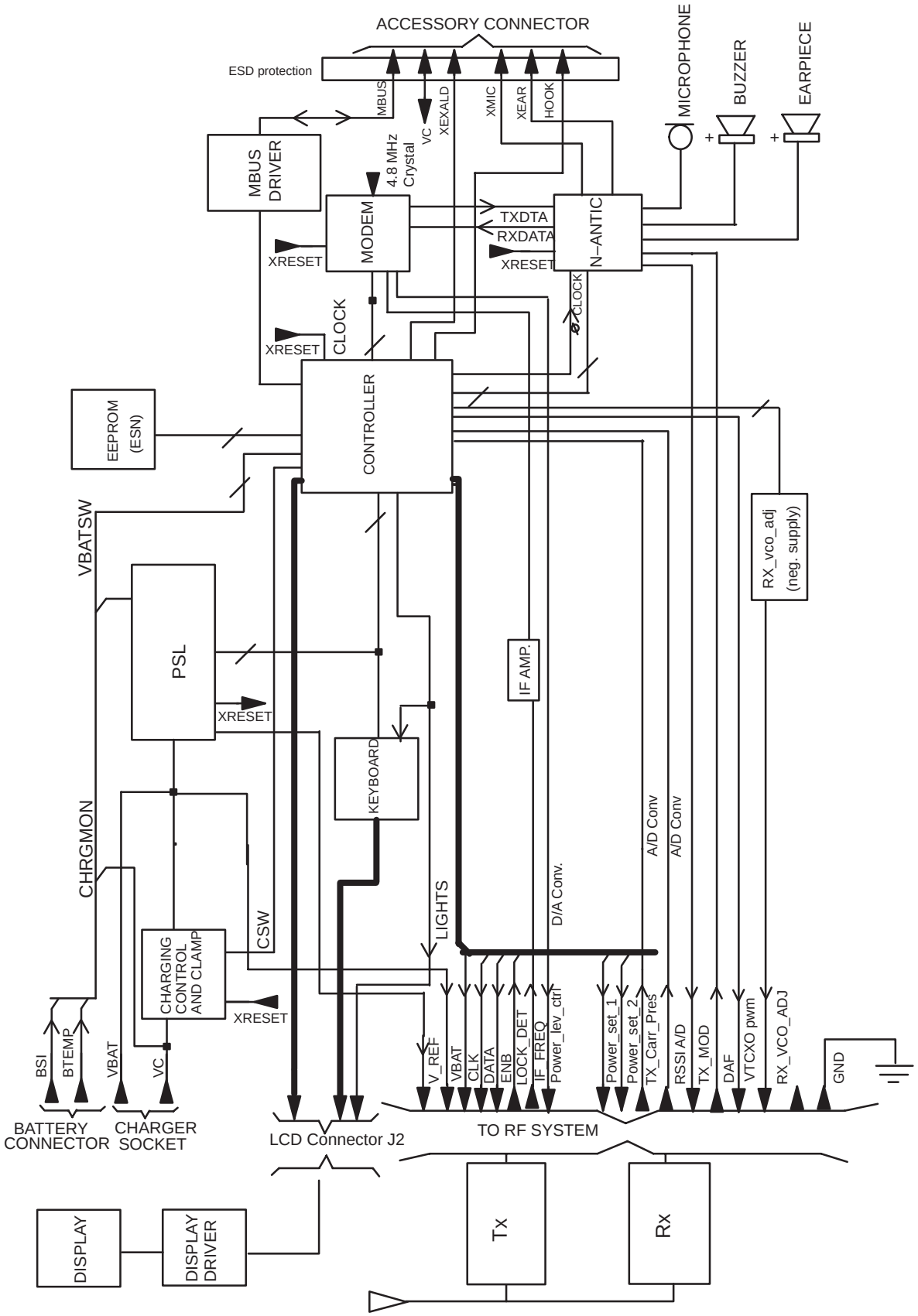


Figure 2: Baseband Block Diagram



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Chapter 4

SYSTEM MODULE

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Introduction

General

The system module controls the operation of the internal parts of the phone. Its task is to control the user interface, i.e. LCD driver, keyboard, and audio interface functions. The module performs all signalling towards the system and carries out audio–frequency signal processing. In addition, it controls charging, the operation of the transceiver and also stores tuning data for the phone.

The RF unit receives and demodulates the radio frequency signal from the base station and transmits the modulated signal to the base station.

Special Features

- Accessory connector at bottom, e.g. for RF booster and handsfree junction box.
- RF connector at bottom, with RF switch for connection to accessories.
- Extra lines to processor and ordinary lines with additional functions to communicate with accessories.

Technical Specifications

Modes of Operation

As well as charging the module has two other active operating modes as follows:

- Conversation mode
- Listening mode

In the conversation mode all IC’s are active.

In the listening mode some blocks of the audio IC N_ANTIC are in standby state. The transmitter and the TX synthesizer are switched off.

External Signals and Connections

The module has two external connectors, the system connector and the display module connector. The system connector incorporates the charging connector, the accessory connector and the external antenna connector.

System Connector J1

Pin	Name	Description
1	VC	Charger Input +vc
2	XEXAUD	Booster power control output.
3	HOOK	On hook indication for handsfree operation.
4	XEAR	External earphone signal.
5	0V	0V for both charger and audio.
6	VC	Charger input +vc
7	MBUS	Bidirectional asynchronous data bus.
8	0V	0V for both charger and audio
9	XMIC	External microphone signal
10	0V	0V for both charger and audio
11	0V	For charger
12	VC	Charger input +ve
13	VC	Charger input +ve
14	0V	0V for charger
15	0V	0V
16	RF	RF signal to duplex filter
17	RF	RF signal to antenna
18	0V	0V
19	VBAT	Battery voltage
20	BTEMP	Battery temperature measurement, 27k pull–up resistor to 4.85V.
21	BSI	Battery size indication, 100k pull–up resistor to +4.85V
22	0V	0V for battery

Display Module Connector J2

Pin	Name	Description
1	ROW1	Row 1 of keypad matrix.
2	COL0	Column 0 of keypad matrix
3	ROW0	Row 0 of keypad matrix
4	COL3	Column 3 of keypad matrix
5	VBAT	Battery voltage power for LEDs
6	LCD LIGHTS	Current supply for LCD backlights
7	LCD_CLK	Clock for LCD driver
8	LCD_RES	Reset for LCD driver
9	XLCDEN	LCD driver for chip enable
10	C_XD	Command/No data
11	SCL	Serial data clock
12	VL2	Supply voltage for LCD driver
13	XBUSY	Busy signal from LCD driver
14	0V	0V power connection
15	SDA	Serial data
16	V_LCD	Negative voltage for LCD
17	NC	
18	NC	

NOTE: NC = No Connection

Internal Signals

Connections between RF and Baseband

Pin Name	Description
VBATT	Battery Supply Voltage
Vref	Reference Voltage (4.85 Vdc nom.)
GND	power Supply Ground
VCTCXO	PWM Control for AFC purpose
CLK	Synthesizer Serial Clock
DATA	Synthesizer Serial Data
ENB	Synthesizer Enable
Lock_Detect	Detection of TX Synthesizer lock status
DAF	Demodulated received audio and data
RSSI A/D	Received signal strength indicator
IF_FREQ	2. Intermediate frequency for AFC purpose
RX_VCO_ADJ	Negative adjustable voltage for tuning RX VCO
TX_mod	Transmit modulation output for TX_VCO
Power_level_set_1	Power Control Bit 1
Power_level_set_2	Power Control Bit 2
Power_level_ctrl	DAC value for setting the correct output power
TX_Carr_Pres	TX carrier present – TX transmitting or not– used for fault detection

Functional Description

Logic Circuit Description

General

The audio/logic unit consists of 5 IC’s: controller D101, modem D100, audio N_ANTIC N100, memory D102, regulator PSL N101.

Microcontroller

Controller D101 has six 8–bit I/O ports (Ports 1, 3, 4, 5, 7 and 9), one 5–bit port (Port 2), one 4–bit I/O port (Port 6) an 10–bit 8–channel A/D converter (Port 8), three PWM timers, serial communication interface. All memory (124 kB ROM, 4 kB RAM), except EEPROM, is located in the controller.

Microprocessor D101 Pinout

Pin	Name	I/O	Description
1	A1	O	Address bit1 for modem
2	XCS	O	Chip select for modem
3	XRD	O	Read Strobe to Modem
4	XWR	O	Write Strobe to Modem
5	VL1	I	Digital supply voltage
6	VL1	I	Mode Select – ’1’
7	VL1	I	—”— ’1’
8	VL1	I	—”— ’1’
9	XSTDBY	I	HW Standby Mode Input
10	XRES	I	Reset Input
11	NMI	I	Modem Interrupt (non maskable)
12	DGND	I	Digital Ground
13	D0	I/O	Data bit 0 to modem
14	D1	I/O	
15	D2	I/O	
16	D3	I/O	—”—
17	D4	I/O	
18	D5	I/O	
29	D6	I/O	
20	D7	I/O	Data bit 7 to modem
21	RX_D/A 1	O	MSB in data setup to RX_VCO_ADJ (negative supply)

Pin	Name	I/O	Description
22	RX_D/A 2	O	
23	RX_D/A 3	O	LSB in data setup to RX_VCO_ADJ (negative supply)
24	NC	O	Reset to Output High
25	NC	O	Reset to Output High
26	IF–Amplifier supply enable	O	Reset to ’1’ Turn to ’0’ when on a control channel and in stdby mode.
27	Power_level_set_1		PA stage power controll bit 1
28	Power_level_set_2		PA stage power controll bit 2
29	DGND		Digital Ground
30	ROW 0		Keypad Input and power up control
31	ROW 1		Keypad Input
32	ROW 2		—”—
33	ROW 3		—”—
34	ROW 4		—”—
35	ROW 5		—”—
36	ROW 6		—”—
37	OUT_T	O	Time OUT in NMT – Used for Buzzer volumen
38	COL 0		Keypad Output and power up control
39	COL 1		Keypad Output
40	COL 2		Keypad Output
41	COL 3		Keypad Output
42	VL1		Digital supply voltage
43	NC	O	Reset to Output High
44	LIGHTS	O	Keypad and LCD Lights on/off Reset to ’0’
45	NC	O	Reset to Output High
46	MBUSNF		MBUS net free timer input
47	CLK	O	Synthesizer clock
48	DATA	O	Synthesizer data
49	ENB	O	Synthesizer enable
50	Charge enable	O	Call on charging when ’0’

Pin	Name	I/O	Description
51	AGND	I	Analog Ground – for A/D converter
52	VBATSW	I	Battery Voltage Monitor
53	CHRGMON	I	Charger Voltage monitor
54	RSSI	I	Received signal Strength Indicator A/D conv. Input
55	TX carr pres	I	TX carr pres A/D input
56	BTEMP	I	Battery Temperature A/D–converter input
57	AD_5	I	Hook detection input from accessory connector
58	BSI	I	Battery Size Indication
59	HFJCON	I	Hands Free Junction Box sensor
60	Vref	I	A/D converter Reference Voltage
61	ANTSDA	I/O	N_ANTIC Serial Data
62	Lock_detect	I	TX synthesizer lock detector
63	XEXAUD	O PWM1	PWM Output to Accessory Connector – Booster
64	VCTCXO	O PWM2	Frequency trim control voltage for VCTCXO
65	CSW	O PWM3	(Charger Switch) Pulse Width Modulated Charger Control
66			Transmit Serial Data to M2BUS
67			Received Serial Data from M2BUS
68	SCL	I/O	IIC Synchronous clock for EEPROM and LCD serial data
69	HB_EXTAL	I	MCU clk from modem 4.8 MHz
70	NC		
71	DGND	I	Digital Ground
72	ACLK	O	Analog Clk – phi Clk/2 for N_ANTIC (2.4 MHz)
73	XBUSY	I	Busy signal from the LCD Driver
74	XLCDEN	O	LCD Driver Enable/Select
75	C_XD	O	LCD Driver and EEPROM Multiplexer control
76	CSCK	I/O	N_ANTIC Serial Clk (Serially interface lock)
77	CLK STEP	O	Renamed from SYN CLK. Used to pull in the baseband crystal osc. frequency.

Pin	Name	I/O	Description
78	NMI	I	Modem Interrupt (non maskable)
79	SDA	I/O	IIC Serial Data for EEPROM and LCD
80	A0	O	Adress bit 0 for modem

Modem

The NAT D100 is a single VLSI chip modem used for the NAMPS/TACS mobile telephone. It implements a Manchester data receiver–transmitter, and provides supervisory audio tone (SAT) and signalling tone (ST) functions. Received messages are corrected and checked by 3/5 voting and BTH decoding blocks.

Modem (D100) Signals

Name	Description
INT	interrupt output to controller
XCLR	reset input
XCS	chip select from controller
D0–7	data bus to controller
A0–1	address lines for register selection
XRD, XWR	read/write control from controller
DI	data input from RF unit
DO	data output to ANTIC
C1–2	clock generator
CLOCKOUT	system clock output to controller and PIC
DAC 0	dac o/p to Power_Level_Ctrl.

Regulators

Regulator PSL (N101) is the power supply circuit for battery operated applications requiring separate voltage supplies (for the microcontroller, logic and analog functions). It has three voltage regulators (VL1, VL2 and VA), a reference voltage output (VREF), power on/off and reset logic, and a watch dog, in addition to circuitry for supply voltage and battery charger monitoring functions.

PSL N101 Signals

Name	Description
VBAT	battery voltage input
VREF	voltage reference output (+4.85V ±2 %)
VL1	logic voltage output (+4.8 V) for controller
VL2	logic voltage output (+4.8 V) for other logic
VA	analog voltage output (+4.8 V)
VBATSW	switched VBAT voltage
XPWRON	power on control input from key-board
XPWROFF	power off control from controller (watchdog)
XRESET	reset control output for logic
XSTBY	standby control for controller
CHRGDET	battery charger detection input
DETIN	supply voltage detection input
CRESET	connection for external timing capacitor defining reset signal delay
COFF	connection for an external timing capacitor defining power off delay
CPOR	connection for external capacitor for controlled power on master reset
GND	ground (analog/logic)

Memories

EEPROM D102 comprises non–volatile memory into which are stored the tuning data for the phone. In addition, D102 contains 99 short code memory locations to retain user selectable phone numbers. EEPROM data signal SDA is fed to the display modules multiplexer, where the signal is divided into two SDA lines.

EEPROM D102 Signals

Name	Description
SCL	IIC bus clock
SDA	IIC bus data

Charging Control

The charging circuit is fully controlled via software determined from **B**attery **S**ize **I**ndicator and **B**attery **TEMP**erature A/D converter inputs.

The BTEMP is derived from an incorporated thermistor in the battery pack and converted to real temperature via a table in SW, which decides where the critical limits for charging is.

The BSI resistor is built in the battery package and designed to give an A/D reading of 344 – (1.63 V at A/D converter) per Ah battery capacity. The actual capacity is then calculated from the reading to mAh by: A/D*32/11.

In principle the charging circuit contains a basic serial power switch controlled via a pair of parallel transistors responsible for a controlled power up when a charger is inserted. For approx. 1s the PSL is the controller and turns on the series switch (XRES low) to ensure that a flat battery is sufficiently charged before the MCU can take over. When powered up the MCU can pulse width modulate the PW3 line so that a fast or slow charge can take place and determine which charger is connected. The MCU makes a decision dependent of the chrgmon value (A/D converter).

Display Lighting

Display lighting is generated by V414, V419,V415,R400, R401, and R402. The lighting is controlled by the controller.

Audio Circuit Description

Transmit (TX) Signal Path

The TX audio signal is processed in the N_ANTIC and fed, via the MOD line, to the synthesizer. N_ANTIC contains the following stages for TX signal processing:

Name	Description
MICAMP	Signal from the microphone is fed to this stage and amplified
MUX	TX source selection (EXMIC/MIC/DTMF/MUTED)
TXAAFIL	Anti alias filter (see N_ANTIC specification)
BANDPASS	(see N_ANTIC specification)
TXATT	For handsfree mode of operation
COMPRESSOR	2:1 syllabic compressor
PREEMP	Pre–emphasis filter
AGC	Soft Limiter
LIMU	Hard limiter
LOWPASS	Low pass notch filter
POSTFIL	Second order Sallen–Key filter
SUMSTAGE	Data from modem is summed in here
TRCOMP	Modulation sensitivity compensation

Receiver (RX) Audio Signal Path

The demodulated audio signal (DAF) from the receiver is fed to the N_ANTIC circuit which contains a software controlled receiver and compensation amplifier. The output of this stage drives the modem IC and the remaining N_ANTIC RX signal processing stages.

Name	Description
MUX	RX source selection (DTMF/DAF1/DAF2)
RXAAFIL	Anti alias filter
RXFIL	Second order Sallen–Key filter
EXP	2:1 Syllabic Expander
VOLUME	Volume Control Amplifier
RXATT	For Handsfree mode
EARPAMP	The earphone amplifier is a single input, differential output amplifier for a ceramic earpiece
ACCAMP	Accessory amplifier – buffer for XEAR output

RF Circuit Description

Receiver

The receiver is a dual–conversion superheterodyne using two intermediate frequencies, 86.85 MHz and 450 kHz.

The RF signal from the duplexer RX port is applied to the Low Noise amplifier. The amplifier is realized with transistor V200. Amplifier stage input matching is accomplished by C201 and L217. R200 and R201 are used for biasing. Output matching is carried out by L216, R211 and C325.

Components C326 and C329 are used for RF bypassing. C200 and C202 are for amplifier stabilization. The Low Noise amplifier and the IF circuit are connected in series with R202 so that the same supply current is passed through both stages. The signal is then filtered with Z202.

The filter is followed by a single balanced diode mixer, realized with C207,C208, Z205, Z204, Z203 and V201. Input matching from the Rx SAW filter is realized by C205 and L201.

The signal is then filtered with a saw filter Z206. Input and output impedances are 600 ohm // 3pF. The filter and the IF amplifier stage are matched by C210 and L203.

The IF amplifier is realized with transistor V202; R205 and R206 are used for biasing, R203 and C209 are for amplifier stabilization. The IF amplifier stage and the second mixer are matched by R204 and C220.

The second mixer, the oscillator transistor, IF amplifier, LIM amplifier, quadrature detector and audio amplifier are all integrated in the circuit N201. The second LO frequency, 86.4 MHz, is realized by multiplying VCTCXO (14.4MHz) six times. This multiplier is realized with transistor V225, R226 and R303 being used for biasing. R299 and C324 are for stabilization.

L215, C323 and C219 is the bandpass filter for 86.4 MHz. C265 and C219 are used for DC blocking. L204 and C215, are connected to OSCOUT. After the mixer, the 450 kHz IF signal is fed to the multiplexer circuit N200. Z207 is a narrow ceramic filter for NAMPS and Z208 is a wide ceramic filter for AMPS. A multiplexer circuit is used to switch between these filters. The LIM amplifier output signal is fed through C223 to a quadrature detector. After this, the signal is phase shifted by resonance circuit C225, R214 and L205.

Signal DAF is low pass filtered by R212, C222 and R213. The 2nd IF, DAF and RSSI signal (450 kHz) is fed to the audio/logic unit.

RX Synthesizer

The first injection frequency (1st LO) is obtained from a voltage controlled oscillator (VCO) V205. The VCO output signal is amplified by transistor V204 and fed to the receiver mixer via Z05. The injection level required by the receiver mixer is nominally +3 dBm. In addition, the signal is fed through C230 to a buffer amplifier and divider chain in the synthesizer circuit N202 and via R297 to an amplifier V212 in the TX synthesizer.

The VCO output frequency is locked to a stable reference frequency by means of a phase locked loop (PLL) with N202. N202 is a dual–synthesizer circuit, comprising; two independent programmable main dividers, phase detectors, chargepumps, a common programmable reference divider, a voltage doubler for the chargepump supply and 3 programmable output ports. Half of the circuit is used for the RX synthesizer, the other half for the TX synthesizer.

The internal main dividers of N202 are programmed with 21 bits each, which are transferred serially on the SDATA (synthesizer data) line from the processor into an internal shift register also located in N202. Data transfer is timed with CLK clock pulses. After the transfer, the ENB (RX synthesizer latch enable) line goes high and the data is latched to N202.

The VCO frequency is divided down and compared with a highly stable comparison frequency, derived from a reference oscillator, by a phase comparator in the PLL circuit (N202). The phase comparator output switches a chargepump, controlling the VCO frequency, by means of a DC voltage through the loop filter. This keeps the divided frequency applied to the phase comparator equal to the fixed comparison frequency.

The comparison frequency is 10 kHz. It is not always equal to the channel spacing (AMPS: 30 kHz, NAMPS: 10 kHz). This reference frequency is obtained from a voltage controlled, temperature compensated, crystal oscillator (VCTCXO) G200. Oscillator frequency is 14.4 MHz. The VCTCXO frequency is divided by 1440 in AMPS and NAMPS.

The chargepump output at pin 3 delivers positive or negative current pulses to the loop filter, consisting of R229, R228, R227, C250, C248, C247 and C246. This converts these pulses to a DC voltage and filters the remaining ripple. The DC control voltage is routed to the VCO varicap diode V206 and so controls the VCO frequency.

If the VCO frequency is too low, the chargepump will deliver positive current to the loop filter. Thereafter the DC control voltage and the VCO frequency will go up. When the VCO frequency is correct and the synthesizer is locked to the desired frequency (channel), the chargepump output is in a high impedance state.

The VCO is a Clapp type oscillator. The oscillator’s resonant frequency is determined by the circuitry Z209, C245, C239, C240, C241, C237 plus the control voltage at the cathode of varicap V206. The centre frequency of the VCO is adjusted by changing the negative voltage on the anode of V206.

The VCO signal is amplified by buffer amplifier V204. This amplifier produces +3 dBm to the first mixer via Z06. The same buffer produces a level of –15 dBm to the divider–buffer in N202 and –10dBm to the amplifier V212 in the TX synthesizer via C230.

Transmitter

The transmitter concept consist of following circuit blocks: TX–mixer, TX–mixer amplifier, TX–SAW filter, Driver–, PA–module–, Lowpass filter, Directional coupler– and the Power Control circuitry.

TX MIXER.

The TX–frequency is obtained by mixing the RX–VCO signal with the TX–VCO signal. The TX–mixer is implemented as a single balanced diode (V211) mixer, where the mixer transformer is implemented in the PCB .

TX MIXER AMPLIFIER.

To compensate for the TX mixer conversion loss and to achieve a proper impedance match to the SAW filter, an amplifier is needed. The matching and amplification is done by a single bipolar transistor (V213) stage.

TX SAW FILTER.

To reduce the spurious effects from the TX mixer, the output frequency bandwidth of both the TX mixer and Mixer buffer output is limited. This prevents problems with the TX–VCO harmonics at the antenna and quieting in the receiver. The TX signal spectrum is limited by a SAW filter (Z210) before it is fed into the following driver stage.

DRIVER CIRCUITRY.

To obtain sufficient power drive level to the Power module and avoid the VCO kicking in during PA start up, a single bipolar transistor (V219) amplifier stage is needed.

PA MODULE CIRCUITRY.

The output power circuitry consist of a three stages Gallium Arsenide Heterojunction bipolar transistor high power amplifier IC (N203) : The input stage is operating class A, and the second stage is operating in class AB, and the final stage is operating in class B.

The first two stages are easy to match with external drain matching networks. The output stage has a relative low resistive output impedance and requires a proper matching network to obtain a power efficient and stable PA stage. No additional Lowpass filter is required to remove the harmonics of the transmitter between the TX power output stage and the duplexer in order to fulfil the TX spurious rejection specification.

The module is based on GaAs technology and does not require any negative gate voltage, giving a simpler bias circuitry and safer construction. The power module has an internal bias circuit, which makes it possible to control the gain of the module with digital logic and analogue level signals: two bits are used for controlling the gain in ten dB steps: an analogue input signal is used to power the module ‘On’ and ‘Off’ and control the module’s RF output power level. All stages are supplied from and connected directly to the battery line.

The PA–IC is a SMT type and the grounding of the PCB will be used as a heat sink for the power stage.

Directional coupler circuitry

A voltage proportional to the output power is rectified from a directional coupler. This rectified voltage is fed into the feedback input of power control circuitry.

Power Control circuitry.

The power control circuit is biased of a discrete build differential transistor (V215) amplifier stage, where the rectified voltage is fed to the negative input and compared with the reference voltage connected to the positive input. The reference voltage is a lowpass filtered D/A signal from the baseband circuitry. The differential amplifier adjusts the collector voltage of serial the transistor (V216) to the reference voltage and the voltage proportional to the output power are equal.

TX Synthesizer

The transmitter synthesizer generates a frequency modulated transmitter signal for the transmitter section.

The TX offset synthesizer consists of a 131.85 MHz PLL circuit, passive loop filter and a VCO equipped with a chip coil resonator. Modulation is brought to the VCO.

The TX signal is obtained by mixing the signals of offset synthesizer and RX synthesizer with a single balanced diode mixer. From the mixer the –15 dBm level is fed to the amplifier V213. The TX signal is filtered with a SAW filter before inputting it to the transmitter.

The VCO is a Clapp type oscillator. The oscillator’s resonance frequency is determined by the circuitry L210, C273, C268, V208, C274, and C275. The center frequency of the resonance circuit is not adjustable (By increasing or decreasing the capacitor C273 the resonance frequency can be changed). The VCO signal is amplified by V209 and fed to the PLL circuit and to the mixer.

The transceiver unit is equipped with an AFC function, i.e. it uses the incoming receive signal from the base station as a frequency reference. The control loop consists of the receiver, the IF counter in the modem (D100), CPU (D101), an 8–bit D/A converter in the modem and the VCTCXO, which is used as a reference oscillator for the synthesizer.

The 2nd IF signal (450 kHz) from the receiver is fed to the audio/logic unit, where it is buffered and fed to the modem. The IF counter counts the received frequency. If the frequency differs from the programmed value, the CPU adjusts the frequency of the VCTCXO by changing the output voltage of the D/A converter. This adjustment continues until the desired receive frequency is achieved. AFC is not active during a channel scan.

Regulator transistors V221 and V222 form a voltage regulator for the receiver. It is realized with discrete transistors because the output noise has to be very low. The 4.85V reference voltage (VREF) comes from the logic module, and is used to shut down VRX when the radio is switched off.

Transistor V217 and V226 form a voltage regulator for the transmitter path. The output voltage can be switched on and off by output port P3 of N202 via current boosting transistor V223.

Parts list KS4S (EDMS Iss. 8.2)

ITEM	CODE	DESCRIPTION	VALUE	TYPE
R100	1411437	Chip resistor	56	5 % 0.12 W 1206
R101	1411437	Chip resistor	56	5 % 0.12 W 1206
R102	1411437	Chip resistor	56	5 % 0.12 W 1206
R103	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R104	1411388	Chip resistor	33	5 % 0.12 W 1206
R105	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R106	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R107	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R108	1430792	Chip resistor	33 k	5 % 0.063 W 0402
R109	1430792	Chip resistor	33 k	5 % 0.063 W 0402
R110	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R111	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R112	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R113	1430796	Chip resistor	47 k	5 % 0.063 W 0402
R114	1430828	Chip resistor	820 k	5 % 0.063 W 0402
R115	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R116	1430746	Chip resistor	560	5 % 0.063 W 0402
R117	1430796	Chip resistor	47 k	5 % 0.063 W 0402
R118	1430806	Chip resistor	120 k	5 % 0.063 W 0402
R119	1430792	Chip resistor	33 k	5 % 0.063 W 0402
R120	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R121	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R122	1430780	Chip resistor	12 k	5 % 0.063 W 0402
R123	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R124	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R125	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R126	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R127	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R128	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R129	1430808	Chip resistor	150 k	5 % 0.063 W 0402
R130	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R131	1413829	Chip resistor	10	5 % 0.1 W 0805
R132	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R133	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R134	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R135	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R136	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R137	1430710	Chip resistor	22	5 % 0.063 W 0402
R138	1430804	Chip resistor	100 k	5 % 0.063 W 0402

R139	1430796	Chip resistor	47 k	5 % 0.063 W 0402
R140	1430796	Chip resistor	47 k	5 % 0.063 W 0402
R141	1430828	Chip resistor	820 k	5 % 0.063 W 0402
R142	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R143	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R144	1430812	Chip resistor	220 k	5 % 0.063 W 0402
R145	1430248	Chip resistor	3.9 k	2 % 0.063 W 0603
R146	1430250	Chip resistor	4.7 k	2 % 0.063 W 0603
R147	1430790	Chip resistor	27 k	5 % 0.063 W 0402
R148	1430254	Chip resistor	6.8 k	2 % 0.063 W 0603
R149	1430746	Chip resistor	560	5 % 0.063 W 0402
R150	1430746	Chip resistor	560	5 % 0.063 W 0402
R151	1430776	Chip resistor	8.2 k	5 % 0.063 W 0402
R152	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R153	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R154	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R155	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R156	1430788	Chip resistor	22 k	5 % 0.063 W 0402
R157	1430790	Chip resistor	27 k	5 % 0.063 W 0402
R158	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R159	1430816	Chip resistor	330 k	5 % 0.063 W 0402
R160	1430812	Chip resistor	220 k	5 % 0.063 W 0402
R161	1430294	Chip resistor	220 k	2 % 0.063 W 0603
R162	1413829	Chip resistor	10	5 % 0.1 W 0805
R163	1430730	Chip resistor	150	5 % 0.063 W 0402
R164	1430280	Chip resistor	100 k	2 % 0.063 W 0603
R165	1430816	Chip resistor	330 k	5 % 0.063 W 0402
R166	1430818	Chip resistor	390 k	5 % 0.063 W 0402
R167	1430796	Chip resistor	47 k	5 % 0.063 W 0402
R168	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R169	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R170	1430790	Chip resistor	27 k	5 % 0.063 W 0402
R171	1430792	Chip resistor	33 k	5 % 0.063 W 0402
R172	1430788	Chip resistor	22 k	5 % 0.063 W 0402
R173	1430792	Chip resistor	33 k	5 % 0.063 W 0402
R174	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R175	1430788	Chip resistor	22 k	5 % 0.063 W 0402
R176	1430808	Chip resistor	150 k	5 % 0.063 W 0402
R177	1430796	Chip resistor	47 k	5 % 0.063 W 0402
R178	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R179	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R180	1430792	Chip resistor	33 k	5 % 0.063 W 0402

R181	1430788	Chip resistor	22 k	5 % 0.063 W 0402
R182	1430746	Chip resistor	560	5 % 0.063 W 0402
R183	1430746	Chip resistor	560	5 % 0.063 W 0402
R184	1430774	Chip resistor	6.8 k	5 % 0.063 W 0402
R185	1430774	Chip resistor	6.8 k	5 % 0.063 W 0402
R186	1430792	Chip resistor	33 k	5 % 0.063 W 0402
R187	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R188	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R189	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R190	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R191	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R192	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R193	1430734	Chip resistor	220	5 % 0.063 W 0402
R194	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R195	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R196	1430700	Chip resistor	10	5 % 0.063 W 0402
R197	1430792	Chip resistor	33 k	5 % 0.063 W 0402
R200	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R201	1430774	Chip resistor	6.8 k	5 % 0.063 W 0402
R202	1430700	Chip resistor	10	5 % 0.063 W 0402
R203	1430726	Chip resistor	100	5 % 0.063 W 0402
R204	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R205	1430790	Chip resistor	27 k	5 % 0.063 W 0402
R206	1430774	Chip resistor	6.8 k	5 % 0.063 W 0402
R207	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R208	1430718	Chip resistor	47	5 % 0.063 W 0402
R211	1430744	Chip resistor	470	5 % 0.063 W 0402
R212	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R213	1430774	Chip resistor	6.8 k	5 % 0.063 W 0402
R214	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R215	1430758	Chip resistor	1.5 k	5 % 0.063 W 0402
R216	1430718	Chip resistor	47	5 % 0.063 W 0402
R217	1430758	Chip resistor	1.5 k	5 % 0.063 W 0402
R218	1430766	Chip resistor	3.9 k	5 % 0.063 W 0402
R219	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R220	1430718	Chip resistor	47	5 % 0.063 W 0402
R221	1430726	Chip resistor	100	5 % 0.063 W 0402
R222	1430726	Chip resistor	100	5 % 0.063 W 0402
R223	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R224	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R225	1430726	Chip resistor	100	5 % 0.063 W 0402
R226	1430804	Chip resistor	100 k	5 % 0.063 W 0402

R227	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R228	1430796	Chip resistor	47 k	5 % 0.063 W 0402
R229	1430794	Chip resistor	39 k	5 % 0.063 W 0402
R230	1430788	Chip resistor	22 k	5 % 0.063 W 0402
R231	1430796	Chip resistor	47 k	5 % 0.063 W 0402
R232	1430796	Chip resistor	47 k	5 % 0.063 W 0402
R233	1430718	Chip resistor	47	5 % 0.063 W 0402
R234	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R235	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R236	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R237	1430792	Chip resistor	33 k	5 % 0.063 W 0402
R238	1430730	Chip resistor	150	5 % 0.063 W 0402
R239	1430734	Chip resistor	220	5 % 0.063 W 0402
R240	1430748	Chip resistor	680	5 % 0.063 W 0402
R241	1430746	Chip resistor	560	5 % 0.063 W 0402
R242	1430744	Chip resistor	470	5 % 0.063 W 0402
R243	1430758	Chip resistor	1.5 k	5 % 0.063 W 0402
R244	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R246	1430790	Chip resistor	27 k	5 % 0.063 W 0402
R247	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R248	1430758	Chip resistor	1.5 k	5 % 0.063 W 0402
R250	1430726	Chip resistor	100	5 % 0.063 W 0402
R251	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R252	1430832	Chip resistor	2.7 k	5 % 0.063 W 0402
R253	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R254	1430718	Chip resistor	47	5 % 0.063 W 0402
R255	1430700	Chip resistor	10	5 % 0.063 W 0402
R256	1430734	Chip resistor	220	5 % 0.063 W 0402
R257	1430700	Chip resistor	10	5 % 0.063 W 0402
R258	1430710	Chip resistor	22	5 % 0.063 W 0402
R259	1430774	Chip resistor	6.8 k	5 % 0.063 W 0402
R260	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R261	1430732	Chip resistor	180	5 % 0.063 W 0402
R262	1430726	Chip resistor	100	5 % 0.063 W 0402
R263	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R264	1430788	Chip resistor	22 k	5 % 0.063 W 0402
R265	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R266	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R267	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R268	1430754	Chip resistor	1.0 k	5 % 0.063 W 0402
R269	1430691	Chip resistor	2.2	5 % 0.063 W 0402
R271	1430710	Chip resistor	22	5 % 0.063 W 0402

R273	1430718	Chip resistor	47	5 % 0.063 W 0402
R274	1430806	Chip resistor	120 k	5 % 0.063 W 0402
R275	1430796	Chip resistor	47 k	5 % 0.063 W 0402
R276	1430796	Chip resistor	47 k	5 % 0.063 W 0402
R277	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R278	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R279	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R280	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R281	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R282	1430774	Chip resistor	6.8 k	5 % 0.063 W 0402
R283	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R284	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R286	1430784	Chip resistor	15 k	5 % 0.063 W 0402
R287	1430770	Chip resistor	4.7 k	5 % 0.063 W 0402
R288	1430726	Chip resistor	100	5 % 0.063 W 0402
R289	1430700	Chip resistor	10	5 % 0.063 W 0402
R290	1430726	Chip resistor	100	5 % 0.063 W 0402
R291	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R292	1430788	Chip resistor	22 k	5 % 0.063 W 0402
R293	1430766	Chip resistor	3.9 k	5 % 0.063 W 0402
R294	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R295	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R296	1430796	Chip resistor	47 k	5 % 0.063 W 0402
R297	1430726	Chip resistor	100	5 % 0.063 W 0402
R298	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R299	1430726	Chip resistor	100	5 % 0.063 W 0402
R300	1430710	Chip resistor	22	5 % 0.063 W 0402
R301	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R302	1430788	Chip resistor	22 k	5 % 0.063 W 0402
R303	1430790	Chip resistor	27 k	5 % 0.063 W 0402
R304	1430788	Chip resistor	22 k	5 % 0.063 W 0402
R305	1430766	Chip resistor	3.9 k	5 % 0.063 W 0402
R401	1411363	Chip resistor	22	5 % 0.12 W 1206
R402	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
R403	1430161	Chip resistor	27	5 % 0.063 W 0603
R407	1430778	Chip resistor	10 k	5 % 0.063 W 0402
R408	1430804	Chip resistor	100 k	5 % 0.063 W 0402
R409	1430774	Chip resistor	6.8 k	5 % 0.063 W 0402
R410	1800673	NTC resistor	15 k	10 % 0.12 W 0805
R411	1430726	Chip resistor	100	5 % 0.063 W 0402
R412	1430762	Chip resistor	2.2 k	5 % 0.063 W 0402
C100	2320546	Ceramic cap.	27 p	5 % 50 V 0402

C101	2320548	Ceramic cap.	33 p	5 % 50 V 0402
C102	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C103	2320047	Ceramic cap.	33 p	5 % 50 V 0603
C104	2320047	Ceramic cap.	33 p	5 % 50 V 0603
C105	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C107	2307816	Ceramic cap.	47 n	20 % 25 V 0805
C108	2307816	Ceramic cap.	47 n	20 % 25 V 0805
C109	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C110	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C111	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C112	2307816	Ceramic cap.	47 n	20 % 25 V 0805
C113	2307816	Ceramic cap.	47 n	20 % 25 V 0805
C114	2307816	Ceramic cap.	47 n	20 % 25 V 0805
C115	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C116	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C117	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C118	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C119	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C120	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6
C121	2307816	Ceramic cap.	47 n	20 % 25 V 0805
C122	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C123	2310537	Ceramic cap.	820 p	5 % 50 V 0805
C124	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6
C125	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C126	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C127	2307816	Ceramic cap.	47 n	20 % 25 V 0805
C128	2320540	Ceramic cap.	15 p	5 % 50 V 0402
C129	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C130	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C131	2320540	Ceramic cap.	15 p	5 % 50 V 0402
C132	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C133	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6
C134	2307816	Ceramic cap.	47 n	20 % 25 V 0805
C135	2307816	Ceramic cap.	47 n	20 % 25 V 0805
C136	2307816	Ceramic cap.	47 n	20 % 25 V 0805
C137	2604127	Tantalum cap.	1.0 u	20 % 35 V 3.5x2.8x2.1
C138	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6
C139	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C140	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C141	2604287	Tantalum cap.	3.3 u	20 % 16 V 3.5x2.8x2.1
C142	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C143	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6

C144	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C145	2604022	Tantalum cap.	0.1 u	20 % 35 V 3.2x1.6x1.6
C146	2604079	Tantalum cap.	0.22 u	20 % 35 V 3.2x1.6x1.6
C147	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C148	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C149	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C150	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6
C151	2604199	Tantalum cap.	2.2 u	20 % 3.2x1.6x1.6
C152	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6
C153	2307816	Ceramic cap.	47 n	20 % 25 V 0805
C154	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C155	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C156	2320548	Ceramic cap.	33 p	5 % 50 V 0402
C157	2320548	Ceramic cap.	33 p	5 % 50 V 0402
C158	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C159	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C160	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C161	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C162	2307816	Ceramic cap.	47 n	20 % 25 V 0805
C163	2307816	Ceramic cap.	47 n	20 % 25 V 0805
C164	2307816	Ceramic cap.	47 n	20 % 25 V 0805
C165	2307816	Ceramic cap.	47 n	20 % 25 V 0805
C166	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C167	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C199	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C200	2320598	Ceramic cap.	3.9 n	5 % 50 V 0402
C201	2320540	Ceramic cap.	15 p	5 % 50 V 0402
C202	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C204	2610003	Tantalum cap.	10 u	20 % 10 V 3.2x1.6x1.6
C205	2320604	Ceramic cap.	18 p	5 % 50 V 0402
C207	2320520	Ceramic cap.	2.2 p	0.25 % 50 V 0402
C208	2320526	Ceramic cap.	3.9 p	0.25 % 50 V 0402
C209	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C210	2320524	Ceramic cap.	3.3 p	0.25 % 50 V 0402
C211	2320604	Ceramic cap.	18 p	5 % 50 V 0402
C212	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C213	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C214	2604329	Tantalum cap.	4.7 u	20 % 10 V 3.5x2.8x2.1
C215	2320538	Ceramic cap.	12 p	5 % 50 V 0402
C216	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C217	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C218	2320598	Ceramic cap.	3.9 n	5 % 50 V 0402

C219	2320516	Ceramic cap.	1.5 p	0.25 % 50 V 0402
C220	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C221	2604329	Tantalum cap.	4.7 u	20 % 10 V 3.5x2.8x2.1
C222	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C223	2320548	Ceramic cap.	33 p	5 % 50 V 0402
C224	2320598	Ceramic cap.	3.9 n	5 % 50 V 0402
C225	2310490	Ceramic cap.	360 p	2 % 50 V 0805
C226	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C227	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C228	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6
C229	2320520	Ceramic cap.	2.2 p	0.25 % 50 V 0402
C230	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C231	2320540	Ceramic cap.	15 p	5 % 50 V 0402
C232	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C233	2320540	Ceramic cap.	15 p	5 % 50 V 0402
C234	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6
C235	2320598	Ceramic cap.	3.9 n	5 % 50 V 0402
C236	2320538	Ceramic cap.	12 p	5 % 50 V 0402
C237	2320540	Ceramic cap.	15 p	5 % 50 V 0402
C238	2604199	Tantalum cap.	2.2 u	20 % 3.2x1.6x1.6
C239	2320524	Ceramic cap.	3.3 p	0.25 % 50 V 0402
C240	2320520	Ceramic cap.	2.2 p	0.25 % 50 V 0402
C241	2320520	Ceramic cap.	2.2 p	0.25 % 50 V 0402
C242	2320548	Ceramic cap.	33 p	5 % 50 V 0402
C243	2611668	Tantalum cap.	4.7 u	20 % 10 V 3.2x1.6x1.6
C244	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6
C245	2320532	Ceramic cap.	6.8 p	0.25 % 50 V 0402
C246	2310544	Ceramic cap.	1.0 n	5 % 50 V 0805
C247	2310583	Ceramic cap.	4.7 n	5 % 50 V 0805
C248	2307816	Ceramic cap.	47 n	20 % 25 V 0805
C249	2320508	Ceramic cap.	1.0 p	0.25 % 50 V 0402
C250	2310752	Ceramic cap.	10 n	20 % 50 V 0805
C251	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C252	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C253	2604329	Tantalum cap.	4.7 u	20 % 10 V 3.5x2.8x2.1
C254	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6
C255	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C256	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C257	2610003	Tantalum cap.	10 u	20 % 10 V 3.2x1.6x1.6
C258	2320520	Ceramic cap.	2.2 p	0.25 % 50 V 0402
C259	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C260	2310784	Ceramic cap.	100 n	10 % 25 V 0805

C261	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C262	2610003	Tantalum cap.	10 u	20 % 10 V 3.2x1.6x1.6
C263	2610003	Tantalum cap.	10 u	20 % 10 V 3.2x1.6x1.6
C264	2610003	Tantalum cap.	10 u	20 % 10 V 3.2x1.6x1.6
C265	2320556	Ceramic cap.	68 p	5 % 50 V 0402
C266	2310784	Ceramic cap.	100 n	10 % 25 V 0805
C267	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C268	2320604	Ceramic cap.	18 p	5 % 50 V 0402
C269	2320598	Ceramic cap.	3.9 n	5 % 50 V 0402
C270	2610003	Tantalum cap.	10 u	20 % 10 V 3.2x1.6x1.6
C271	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C272	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C273	2320544	Ceramic cap.	22 p	5 % 50 V 0402
C274	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C275	2320548	Ceramic cap.	33 p	5 % 50 V 0402
C276	2320552	Ceramic cap.	47 p	5 % 50 V 0402
C277	2320107	Ceramic cap.	10 n	5 % 50 V 0603
C278	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C279	2320538	Ceramic cap.	12 p	5 % 50 V 0402
C280	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C281	2320520	Ceramic cap.	2.2 p	0.25 % 50 V 0402
C282	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6
C283	2320522	Ceramic cap.	2.7 p	0.25 % 50 V 0402
C284	2320526	Ceramic cap.	3.9 p	0.25 % 50 V 0402
C285	2320518	Ceramic cap.	1.8 p	0.25 % 50 V 0402
C286	2320518	Ceramic cap.	1.8 p	0.25 % 50 V 0402
C287	2320538	Ceramic cap.	12 p	5 % 50 V 0402
C288	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C289	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C290	2320524	Ceramic cap.	3.3 p	0.25 % 50 V 0402
C291	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C292	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C293	2320522	Ceramic cap.	2.7 p	0.25 % 50 V 0402
C294	2320047	Ceramic cap.	33 p	5 % 50 V 0603
C295	2320029	Ceramic cap.	5.6 p	0.25 % 50 V 0603
C296	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C297	2320047	Ceramic cap.	33 p	5 % 50 V 0603
C299	2320548	Ceramic cap.	33 p	5 % 50 V 0402
C300	2320548	Ceramic cap.	33 p	5 % 50 V 0402
C301	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C302	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C303	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402

C304	2312296	Ceramic cap.		Y5 V 1210
C305	2320548	Ceramic cap.	33 p	5 % 50 V 0402
C306	2320552	Ceramic cap.	47 p	5 % 50 V 0402
C307	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C308	2320620	Ceramic cap.	10 n	5 % 16 V 0402
C309	2610003	Tantalum cap.	10 u	20 % 10 V 3.2x1.6x1.6
C310	2610003	Tantalum cap.	10 u	20 % 10 V 3.2x1.6x1.6
C311	2610003	Tantalum cap.	10 u	20 % 10 V 3.2x1.6x1.6
C312	2610003	Tantalum cap.	10 u	20 % 10 V 3.2x1.6x1.6
C313	2604329	Tantalum cap.	4.7 u	20 % 10 V 3.5x2.8x2.1
C314	2320548	Ceramic cap.	33 p	5 % 50 V 0402
C315	2320520	Ceramic cap.	2.2 p	0.25 % 50 V 0402
C316	2320516	Ceramic cap.	1.5 p	0.25 % 50 V 0402
C317	2320534	Ceramic cap.	8.2 p	0.25 % 50 V 0402
C318	2604209	Tantalum cap.	1.0 u	20 % 16 V 3.2x1.6x1.6
C319	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C320	2604329	Tantalum cap.	4.7 u	20 % 10 V 3.5x2.8x2.1
C321	2610003	Tantalum cap.	10 u	20 % 10 V 3.2x1.6x1.6
C322	2604199	Tantalum cap.	2.2 u	20 % 3.2x1.6x1.6
C323	2320538	Ceramic cap.	12 p	5 % 50 V 0402
C324	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C325	2320524	Ceramic cap.	3.3 p	0.25 % 50 V 0402
C326	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C329	2320560	Ceramic cap.	100 p	5 % 50 V 0402
C330	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C331	2320546	Ceramic cap.	27 p	5 % 50 V 0402
C332	2320538	Ceramic cap.	12 p	5 % 50 V 0402
C334	2320584	Ceramic cap.	1.0 n	5 % 50 V 0402
C335	2610003	Tantalum cap.	10 u	20 % 10 V 3.2x1.6x1.6
C336	2610003	Tantalum cap.	10 u	20 % 10 V 3.2x1.6x1.6
C337	2610003	Tantalum cap.	10 u	20 % 10 V 3.2x1.6x1.6
C402	2307816	Ceramic cap.	47 n	20 % 25 V 0805
C403	2320556	Ceramic cap.	68 p	5 % 50 V 0402
C404	2307816	Ceramic cap.	47 n	20 % 25 V 0805
C405	2307816	Ceramic cap.	47 n	20 % 25 V 0805
C406	2307816	Ceramic cap.	47 n	20 % 25 V 0805
C407	2307816	Ceramic cap.	47 n	20 % 25 V 0805
C408	2307816	Ceramic cap.	47 n	20 % 25 V 0805
C409	2307816	Ceramic cap.	47 n	20 % 25 V 0805
C410	2604199	Tantalum cap.	2.2 u	20 % 3.2x1.6x1.6
C411	2320522	Ceramic cap.	2.7 p	0.25 % 50 V 0402
L200	3641574	Chip coil	68 n	5 % Q=40 0805

L201	3645005	Chip coil	15 n	10 % Q=12/100 MHz 0603
L202	3608414	Chip coil	560n	12061206
L203	3645015	Chip coil	560 n	10 % Q=15/25 MHz 0603
L204	3645013	Chip coil	220 n	10 % Q=15/25 MHz 0603
L205	3660102	Coil adj.	320 u	2 % Q=80
L206	3645011	Chip coil	68 n	5 % Q=12/100 MHz 0603
L207	3645011	Chip coil	68 n	5 % Q=12/100 MHz 0603
L208	3645009	Chip coil	33 n	5 % Q=12/100 MHz 0603
L209	3645003	Chip coil	12 n	10 % Q=12/100 MHz 0603
L210	3645011	Chip coil	68 n	5 % Q=12/100 MHz 0603
L211	3645011	Chip coil	68 n	5 % Q=12/100 MHz 0603
L212	3645005	Chip coil	15 n	10 % Q=12/100 MHz 0603
L213	3645001	Chip coil	4 n	10 % Q=10/100 MHz 0603
L214	3645011	Chip coil	68 n	5 % Q=12/100 MHz 0603
L215	3645013	Chip coil	220 n	10 % Q=15/25 MHz 0603
L216	3645017	Chip coil	5 n	10 % Q=10/100 MHz 0603
L217	3645001	Chip coil	4 n	10 % Q=10/100 MHz 0603
B100	5140016	Buzzer transducer mmx–01cl20 h50H500		
B101	5140454	Cond. microphone	64+–	3DB H500
B102	4510056	Crystal	4.800 M+–50PPM11.8X5.511.8x5.5	
G200	4510013	SM, VCTCXO 14.40000mhz 10k//10pf		
F100	5119002	Fuse f2a 32v smd 1206		
Z200	9780081	Coax cable b11341		
Z201	4512020	SM, duplexer 824–849/869–894mhzamps		
Z202	4511010	Saw filter	881.5+–12.5 MAMPS	
Z206	4510023	SM, saw bpf 86.85mhz +–15khz(–3d+–15KHZ(–3DB)		
Z207	4556975	Cer.filt 450+–4khz 11.0x6.5x6.3mm11.0x6.5x6.3mm		
Z208	4556922	Cer. filter	L2.2	
Z209	4550003	SM, cer res gbf20 1.27ghz q >160		
Z210	4511012	Saw filter	836.5+–12.5 MAMPS	
V100	4108639	Diode x 2	BAS28	75 V 250 mA SOT143
V101	4219922	Transistor x 2	UM6	
V102	4200875	Transistor	BCX54–16npn 45 V 1.5 A SOT89	
V103	4219904	Transistor x 2	UMX1	npn 40 V SOT363
V104	4219904	Transistor x 2	UMX1	npn 40 V SOT363
V105	4202671	MosFet	BST82	n–ch 80 V 175 mA SOT23
V106	4100285	Diode x 2	BAV99	70 V 200 mA SER.SOT23
V107	4100285	Diode x 2	BAV99	70 V 200 mA SER.SOT23
V108	4100285	Diode x 2	BAV99	70 V 200 mA SER.SOT23
V109	4119902	Diode x 4	IMP11	80 V 0.3 A IMD
V110	4115804	Schottky diode	PRLL5817	20 V 1 A SOD87
V111	4210020	Transistor	BCP69–25pnp 20 V 2 A SOT223	

V112	4219914	Transistor x 2	SOT363
V113	4200226	Darl. transistor	BCV27 npn 30 V 300 mA SOT23
V114	4200226	Darl. transistor	BCV27 npn 30 V 300 mA SOT23
V115	4113828	Trans. supr.	28 V 28 A 600 W DO214AA
V116	4110396	Zener diode	BZX84 5 % 3.0 V 0.3 W SOT23
V117	4100285	Diode x 2	BAV99 70 V 200 mA SER.SOT23
V118	4219908	Transistor x 2	UMT1 pnp 40 V SOT363
V119	4100285	Diode x 2	BAV99 70 V 200 mA SER.SOT23
V120	4100285	Diode x 2	BAV99 70 V 200 mA SER.SOT23
V121	4219904	Transistor x 2	UMX1 npn 40 V SOT363
V122	4108639	Diode x 2	BAS28 75 V 250 mA SOT143
V200	4210004	Transistor	BFG67X npn20V50mA 7.5GHZSOT143
V201	4115802	Sch. diode x 2	4V 30 mA SOT23
V202	4210058	Transistor	MRF947 npn 10 V 50 mA SOT323
V203	4100285	Diode x 2	BAV99 70 V 200 mA SER.SOT23
V204	4210132	Transistor	NE68130 npn 10 V 65 mA SOT323
V205	4210132	Transistor	NE68130 npn 10 V 65 mA SOT323
V206	4110018	Cap. diode	BB135 30 V SOD323
V208	4111092	Cap. diode	BB639 30 V SOD323
V209	4210058	Transistor	MRF947 npn 10 V 50 mA SOT323
V210	4210058	Transistor	MRF947 npn 10 V 50 mA SOT323
V211	4100567	Sch. diode x 2	BAS70–0470V15 mA SERSOT23
V212	4210058	Transistor	MRF947 npn 10 V 50 mA SOT323
V213	4210058	Transistor	MRF947 npn 10 V 50 mA SOT323
V214	4100567	Sch. diode x 2	BAS70–0470V15 mA SERSOT23
V215	4219904	Transistor x 2	UMX1 npn 40 V SOT363
V216	4210054	Transistor	FMMT589 pnp 30 V 1 A SOT23
V217	4210054	Transistor	FMMT589 pnp 30 V 1 A SOT23
V219	4210058	Transistor	MRF947 npn 10 V 50 mA SOT323
V221	4210054	Transistor	FMMT589 pnp 30 V 1 A SOT23
V222	4219904	Transistor x 2	UMX1 npn 40 V SOT363
V223	4210102	Transistor	BC858W pnp 30V 100mA 200MW SOT323
V224	4210052	Transistor	DTC114EE npn RB V EM3
V225	4210058	Transistor	MRF947 npn 10 V 50 mA SOT323
V226	4219904	Transistor x 2	UMX1 npn 40 V SOT363
V400	4864388	Led Green	0603
V401	4864388	Led Green	0603
V402	4864388	Led Green	0603
V403	4864388	Led Green	0603
V404	4864388	Led Green	0603

V405	4864388	Led	Green	0603
V406	4864388	Led	Green	0603
V407	4864388	Led	Green	0603
V408	4864388	Led	Green	0603
V409	4864388	Led	Green	0603
V410	4864388	Led	Green	0603
V411	4864388	Led	Green	0603
V412	4864388	Led	Green	0603
V413	4864388	Led	Green	0603
V414	4200875	Transistor		BCX54–16npn 45 V 1.5 A SOT89
V415	4100285	Diode x 2		BAV99 70 V 200 mA SER.SOT23
V416	4110071	Diode x 2		BAV199 70 V 0.2 A SOT23
V417	4110071	Diode x 2		BAV199 70 V 0.2 A SOT23
V418	4100285	Diode x 2		BAV99 70 V 200 mA SER.SOT23
V419	4200917	Transistor		BC848B/BCW32npn 30V 100mA SOT23
D100	4375026	IC, modem nat		so2 NMP75026 SO28W
D101	0240207	IC, SWMCU		SW THA–41S/42S
D102	4370044	IC, EEPROM		NMP 70044 SO8S
D401	4309569	IC, 6 x inverter		4069SO14
N100	4370118	IC, NANTIC		QFP44
N101	4375022	IC, PSL p–supp		NMP75022 SO20
N200	4309423	IC, 3mux/demux 2ch.anal so		74HC4053 SO16
N201	4349694	IC, if amp+fm detector sso		TA31136 SSO16
N202	4349616	IC, 2xsynth 1.1ghz 3v sso		UMA1015M SSO20
N203	4340033	Power amp.gaas 3		1DBM/800–930 MHZMHZ
N204	4340148	IC, op.amp		TA75S01 SSO5
S400	5200120	Push button switch 6.4x5.2 smd		
X100	5449506	Pin header 1x02 1.25mm angle smd SMD		
X101	5469788	Syst.conn a		4DC+JACK+10AF+1RF SMSMD
X200	9510168	Antenna contact b11114		
X400	5431708	Flexfoil connect 1x18 0.5mm smd		
P001	9854078	PC board		KS4S 142.0x49.0x1.2 m6 2/pa
	9854078	PCB KS4S 142.0X49.0X1.2 M6 2/PA		

Parts List – (Display Module KL1)

ITEM	CODE	DESCRIPTION	VALUE	TYPE
R1	1430778	CHIP RES	10K	5% 0.06W
R2	1430790	CHIP RES	27K	5% 0.06W
R3	1430790	CHIP RES	27K	5% 0.06W
R4	1430790	CHIP RES	27K	5% 0.06W
R5	1430790	CHIP RES	27K	5% 0.06W
R6	1430790	CHIP RES	27K	5% 0.06W
C1	232A001	CHIP CERAMIC CAP	4n7	5% 25V
C2	2320552	CHIP CERAMIC CAP	47p	5% 50V
C3	2320552	CHIP CERAMIC CAP	47p	5% 50V
C4	232A001	CHIP CERAMIC CAP	4n7	5% 25V
D1	4309047	IC LCD DRIVER	uPD7228A	GFP80
V1	4864388	CHIP LED	YELLOW/ GREEN	0603
V2	486H001	CHIP LED	YELLOW/ GREEN	0603
V3	486H001	CHIP LED	YELLOW/ GREEN	0603
V4	486H001	CHIP LED	YELLOW/ GREEN	0603